REMARKS

Claims 1-12 are pending. By this Amendment, claims 1, 5, and 7 are amended. Reconsideration and withdrawal of the prior art rejection is respectfully requested for the reasons set forth below.

In the Office Action, claims 1-12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Gooch, U.S. Patent 6,466,325 in view of Nakagawa et al., U.S. Patent 4,575,304. The Office Action states that it is known to place one or more cameras on a robot arm to view markers placed on an object to help locate and control the robot arm relative to the object, referring to Gooch, and that Gooch notes that it is known that reference points can be placed in known positions. The Office Action further states that Nakagawa shows that it is known to place an object shape measuring arrangement on a robot arm. It is asserted that is would have been obvious to use the known reference system, such as Gooch, with such a shape measuring apparatus because knowing the position of the measuring device accurately would have been useful in the accurate measurement of the shape of the object as a whole.

However, neither Gooch nor Nakagawa discloses or even teaches of the system and method as claimed. Gooch and Nakagawa use traditional object mapping in which points on the object are scanned to determine positioning. Gooch, in fact, is not related to the field of surface determination. Gooch attempts to find an improved way of determining the locations of known points - **provided the geometry (e.g. CAD model) of the part is known** (see col. 1, line 48 – col. 2, line 36). Gooch states that it is known to place control points at known positions on a part; the context being the use of these control points at known positions on an object in order to determine the position of said object in space. (See, col. 1, lines 14-20 – col. 1, lines 34-38).

In distinction, the claimed system and method set out to determine an unknown object surface, provided that a separate network of known points is provided. In the present invention, the point targets need NOT be placed on the object itself, as required in Gooch (column 1, line 19), but instead a network of points at mutually known positions are provided inside the camera's field-of-view. The purpose of the invention is not to determine the location of any object, but rather the position of the measurement camera itself mounted on a robot, relative to said network. This enables all measurements to be made in the same coordinate system, so all object measurements can be related to each other regardless of robot position/orientation. The present invention therefore enables the surface determining sensor to work inside a known relationship with said 'random' network at all times regardless of robot movement, yielding useful surface geometry data for all sides of the object being determined. The camera and network are 'external' to this process and only provided to be able to tie surface data acquired from different positions together without relying on the robot to provide positioning data.

Moreover, while in Gooch the purpose is to determine the position of a movable object by using a camera, in the claimed invention the movable camera observes a network of points that need not have any known relationship with the object. Gooch requires the points to be at known positions in the part coordinate system (col. 1, line 20), while in the present invention the points must only be known relative to each other, but not relative to the object. As an implicit consequence, Gooch requires the camera at all times to view the object, whereas in the claimed invention it may be more advantageous to have the camera look in another direction (e.g. directly away from the object to make sure the network points are never hidden by the object). Further,

this use of a network and camera is not taught in Gooch, and the use of a robot in Gooch is completely absent.

Nakagawa teaches one possible embodiment of a surface scanning or determining apparatus in the conventional style, where the positional accuracy of the robot is relied upon as a means to relate data taken from different positions to each other. The camera is used merely to detect the variations of the stripe pattern and therefore the local surface topology - not to detect the scanner position relative to the overall working envelope.

In distinction, claim 1 recites a system for detection of the surface geometry of an object comprising (1) a sensor unit including (a) an optical scanner for non-touch probing and detection of the surface of an object and (b) a position measuring unit including a camera-based sensor designed for registering an image of a network including reference points in known positions and for determining the position of the sensor unit in a global coordinate system defined by the network of reference points, (2) a robot unit for moving the sensor unit, and (3) a computing unit designed for collection of data from the optical scanner unit and the position measuring unit and for transformation of the data from the optical scanner unit to relate them to the global coordinate system. Neither Gooch nor Nakagawa, nor a combination thereof, suggests of a position measuring unit including a camera based sensor as recited in element (b) above to determine the position of the sensor unit. Further, neither reference uses a computing unit that collects data from such a position measuring unit to relate it to a global coordinate system. The applied prior art relates to detecting the position of an object, not the sensor.

Claim 10 is directed to a method for detection of the surface geometry of an object, including use of a sensor unit comprising apparatus for local, point by point detection of the

surface geometry, a position measuring unit to determine the position of the sensor unit in relation to a network of reference points in known positions relative to a global coordinate system, and a robot unit for moving the sensor unit. The method comprises positioning the sensor unit such that a region of the surface of the object is inside a measurement volume of the apparatus, optically scanning the region by means of the apparatus, determining (by means of the position measuring unit) simultaneously the position of the optical scanning apparatus relative to the coordinate system of the network, and transferring data from the scanning apparatus to a computing unit where data are transformed to the coordinate system of the network and stored. None of the applied prior art suggests of a method which determines the position of the optical scanning apparatus relative to a coordinate system of a network by means of a position measuring unit as claimed in claim 10.

Claim 12 is directed to a method for calibration of a sensor unit which comprises apparatus for local detection of a surface geometry, and a position measuring unit to determine the position of the sensor unit in a global coordinate system relative to a network of reference points in known positions, and where the sensor unit is mounted on a robot unit for movement relative to an object. The method comprises positioning the sensor unit such that at least one of the reference points is inside a measurement volume of the apparatus (which is capable of optical scanning), determining the position of the reference point relative to the optical scanning apparatus, determining (by means of the position measuring unit) simultaneously the position of the sensor unit relative to the coordinate system of the network, repeating steps a-c or b, c until the positions of at least three reference points have been determined relative to the coordinate system of the optical scanning apparatus, and calculating a transformation matrix based on data

registered by the scanning apparatus and the position measuring unit to describe the mutual relationship. None of the applied references suggests of this combination of steps, as explained above.

As set forth in detail above, Gooch and Nakagawa fail to disclose all of the claimed elements, even when combined. Additionally, there is no suggestion in the prior art for making the asserted combination of Gooch and Nakagawa, especially as there is no obvious benefit from combining the two references. Nakagawa teaches the use of the robot to position a surface scanner and means to correctly combine overlapping scans, and Gooch teaches how to obtain a network of points on an object with a known geometry: therefore, there is no need for scanning. Gooch does not teach the use of a 'random' coordinate system for relating several robot (and therefore camera and scanner) positions together. Thus, there would be no reason to combine Gooch and Nakagawa. Even if the combination could be made, Gooch and Nakagawa does not yield the present invention.

It is submitted that claims1, 10, and 12, and their dependent claims, are allowable over the prior art and that the application is in condition for allowance. Should further issues require resolution prior to allowance, the Examiner is requested to telephone the undersigned. Should any fees be necessary for entry of this Amendment, the Commissioner is authorized to charge deposit account 033975.

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Respectfully submitted,

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